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Guidance for Conducting Hazardous Materials Flow Surveys

Final Report
January 1995

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This report provides guidance on how to conduct a commodity flow study for hazardous materials moving by highway. It discusses the need for this type of study and details how to review baseline information and design the study. It includes examples and instructions for collecting the data via field studies, analyzing the results, and applying these results back to the purpose of the study. Descriptions of selected recent state and local hazardous material flow studies are provided. A case study example is included that illustrates how to conduct and complete ahazmat flow survey from beginning to end.

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PREFACE

This report was prepared by the U.S. Department of Transportation=s Research and Special Programs Administration (RSPA), Volpe National Transportation Systems Center. The effort was supported by RSPA=s Office of Hazardous Materials Planning and Analysis under the Associate Administrator for Hazardous Materials Safety. This report provides step-wise guidance for conducting commodity flow studies for hazardous materials moving by highway.

The technical advice of Joseph Nalevanko, Ann Mazzulo, and Richard Hannon of RSPA is gratefully acknowledged.

METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in)	=	2.5 centimeters (cm)
1 foot (ft)	=	30 centimeters (cm)
1 yard (yd)	=	0.9 meter (m)
1 mile (mi)	=	1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp)	=	5 milliliters (ml)
1 tablespoon (tbsp)	=	15 milliliters (ml)
1 fluid ounce (fl oz)	=	30 milliliters (ml)
1 cup (c)	=	0.24 liter (l)
1 pint (pt)	=	0.47 liter (l)
1 quart (qt)	=	0.96 liter (l)
1 gallon (gal)	=	3.8 liters (l)
1 cubic foot (cu ft, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm)	=	0.04 inch (in)
1 centimeter (cm)	=	0.4 inch (in)
1 meter (m)	=	3.3 feet (ft)
1 meter (m)	=	1.1 yards (yd)
1 kilometer (km)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm)	=	0.036 ounce (oz)
1 kilogram (kg)	=	2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg)	=	1.1 short tons

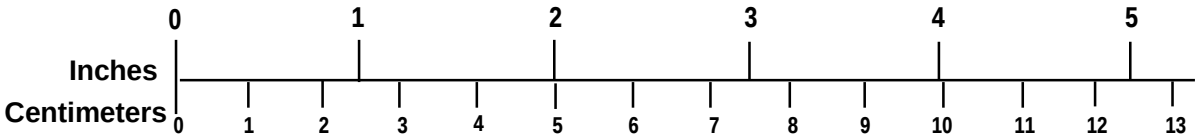
VOLUME (APPROXIMATE)

1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

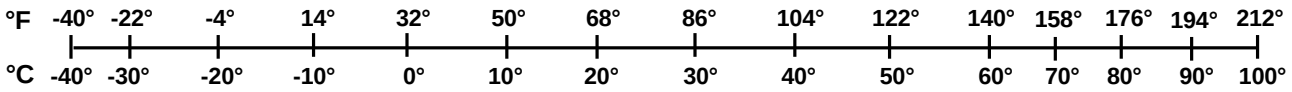
TEMPERATURE (EXACT)

[(9/5) y + 32] °C = x °F

QUICK INCH - CENTIMETER LENGTH CONVERSION



QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSION



For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50 SD Catalog No. C13 10286

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CHAPTER 1
INTRODUCTION

1.1 NEED FOR DOCUMENT

The primary purpose of a commodity flow study is to identify the types and amounts of commodities transported through a specified geographic area, such as a single community, a state, or large urban area, and the routes used for transporting these commodities. A commodity flow study identifies the chemicals transported, either specifically or by hazard class (see Exhibit 1), as well as the routes on which they are transported. It is important for any jurisdiction to understand the flow of hazardous materials through its area to analyze current traffic patterns, better match planning programs to existing needs within communities, and reduce the potential for releasing incidents to occur. These needs can be met in part through the use of a commodity flow study.

This guidance focuses on how to conduct a commodity flow study for hazardous materials. Upon completion of a commodity flow study, planners will have a better understanding of hazardous materials transportation patterns and can use these data to conduct planning and estimate risks facing the jurisdiction. Depending on the specific type of study that is designed and the resources and time available, a commodity flow study can be used to assess total truck traffic, daily and seasonal variations in traffic, awareness and training of drivers and emergency response personnel in the area, and frequently used transportation routes.

The U.S. Department of Transportation (DOT) anticipates increased interest in commodity flow analyses as a result of two sections of the Federal hazardous material transportation law (Federal hazmat law), 49 U.S.C. 5101 et seq. (formerly the HMTA, 49 App. U.S.C. 1801 et seq.), established a grants program for states that wish to address transportation-related risks in emergency response planning and provide training funds for emergency responders. The regulation outlining the requirements of the Federal hazmat law grants program, 49 CFR Part 110, states that "[a]n assessment to determine flow patterns of hazardous materials within a State, between a State and another State or Indian country, and development and maintenance of a system to keep such information current" is one of the activities eligible for funding under the planning grants program. Conducting a commodity flow study could lead to other grant-eligible activities such as assessing the need for regional hazardous materials emergency response teams. More information on the program is available from the grants manager at (202) 366-0001. Second, recent amendments to the Federal hazmat law authorize states to designate highway routes that may be used for the transport of hazardous materials. Prior to designating routes, planners need to analyze the risks associated with hazardous materials transportation within their jurisdiction. Conducting an analysis of commodity flows is an important step in assessing transportation-related hazardous materials risks.

The highway transport of hazardous materials represents about 62 percent of the volume of hazardous materials transported in the U.S., but contributes only a very small fraction of the annual injuries and deaths attributable to hazardous materials transportation incidents. For the 1982-1993 time period, there were a total of 1.5 billion tons of hazardous materials transported in the U.S., 927 million tons of which were shipped by highway. These 927 million tons of hazardous materials were shipped in a total of 467 thousand trucks, which accounted for 93.6 billion ton-miles of hazardous materials traffic. During that time, there were, on average, 6175 incidents per year involving a release of hazardous materials, resulting in approximately 249 injuries. Deaths from hazardous materials incidents totalled an average of 11 per year, including incidents from both vehicular accidents and accidents attributable to other causes (e.g., a faulty valve).

EXHIBIT 1
THE INTERNATIONAL HAZARD CLASSIFICATION SYSTEM

Class numbers represent general categories of chemicals; some classes are further segmented into several divisions to provide a more accurate description of the hazard. Class or division numbers are displayed in the bottom of placards or in the hazardous materials description on shipping papers. Class numbers have the following meanings:

Class 1 Explosive

Class 2 Gas

Class 3 Flammable and

Class 4 Flammable Solid; Spontaneously Combustible Material; Dangerous When Wet Material

Class 5 Oxidizer and Organic Peroxide

Class 6 Poisonous Material and Infectious Substance

Class 7 Radioactive Material

Class 8 Corrosive Material

Class 9 Miscellaneous Hazardous Material

Of the 1.5 billion tons of hazardous materials transported, the majority represent a small subset of hazardous materials and hazard classes. Almost 50 percent of the shipments were gasoline and petroleum products, and approximately 13 percent were chemicals. By decreasing total volume (tons), the major hazard classes/divisions shipped were Class 3 (flammable and combustible liquids), Division 6.1 (poison B), Division 2.3 (poison A), Division 2.1 (flammable compressed gases), and Division 4.1 (flammable solids); by decreasing volume shipped per ton-mile, the hazard classes/divisions were Class 3 (flammable and combustible liquids), Division 6.1 (poison B), Division 4.1 (flammable solids), and Class 8 (corrosives).

A model was recently developed in a study for DOT's Research and Special Programs Administration (RSPA) to allocate commodity flows between producers and consumers. The study was intended to determine whether secondary data sources used in a model could provide estimates of truck movements in the absence of specific data. Using the model, truck movements were estimated for three chemicals, dodecene-1, phosphorus pentasulfide, and 1-butanol. These chemicals were selected from a list of 147 large-volume chemicals that were identified as accounting for at least 80 percent of truck shipments of hazardous chemicals in the United States. Appendix A of this document provides a brief description of the model, a list of the 147 large-volume chemicals, brief overviews of the three chemicals assessed, and graphic displays of the model output for these three chemicals. The results of the three chemicals presented in Appendix A are preliminary. Revised results, which will be presented in subsequent individual reports on the three chemicals, may differ from those reported in Appendix A.

Although such a model may be useful for predicting national trends, state movements of hazardous chemicals can be determined more accurately using a commodity flow study. This guide is intended to assist states in understanding the purposes and uses of commodity flow studies, and to

provide assistance in planning and conducting a study. Although the guide focuses on analyzing hazardous materials transportation along highways, area-specific characteristics might require analysis of other modes of transport.

1.2 ORGANIZATION OF DOCUMENT

This guide provides step-by-step guidance to states, Local Emergency Preparedness Committees (LEPCs), and other planners in assessing hazardous materials transportation patterns. Chapter 2 provides guidance for identification of the objectives of the study (e.g., what data are needed?, how will the data be used?), conducting the study, analysis of the data, and application of the results. Information on identifying study needs, collecting baseline data from other sources, determining the data to be collected, considerations for determining survey locations and personnel needs, and analyzing the results of the study are included. Because this guide focuses on the commodity flow study itself, there is only general discussion of the steps for applying the results to the original objective. Chapter 2 also includes a hypothetical example illustrating considerations for designing and conducting a commodity flow study.

The steps for conducting a commodity flow study might be organized as follows:

1. Review Baseline Information,
2. Design Study,
3. Conduct Commodity Flow Study,
4. Analyze the Results, and
5. Apply the Results to Main Objective.

The main objective may be to characterize the commercial transportation of hazardous materials, or it may require further manipulation of the data during the performance of a subsequent routing risk assessment or other analyses for planning purposes.

Chapter 3 presents descriptions of six studies that have been conducted by states and communities. The examples illustrate the variety of studies that can be designed, and the goals and methods used are described. Chapter 3 also provides a limited discussion of the relative advantages and disadvantages of several methods, depending on the specific purposes of a study. Chapter 4 concludes this guidance with a case study example.